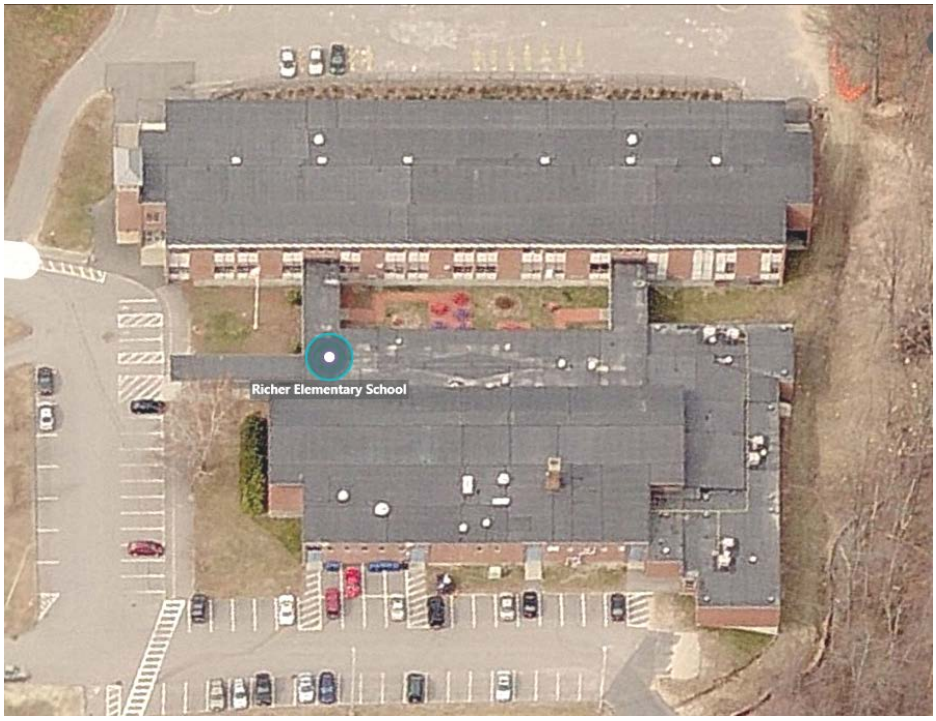
INDOOR AIR QUALITY ASSESSMENT

Richer Elementary School
80 Foley Road
Marlborough, Massachusetts



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
March 2017

Background

Building:	Richer Elementary School (RES)
Address:	80 Foley Road, Marlborough, MA
Assessment Requested by:	Marlborough Public School Department
Reason for Request:	General indoor air quality (IAQ) and mold concerns in below-grade classrooms 113A, 113B, 115A and 115B.
Date of Assessment:	February 10, 2017
Massachusetts Department of Public Health/Bureau of Environmental Health (MDPH/BEH) Staff Conducting Assessment:	Mike Feeney, Director, Indoor Air Quality (IAQ) Program
Building Description:	The original RES was constructed in the mid-1960s. A six classroom single-story addition was built in 1994. A two-story addition that houses the elevator and lobby was constructed in the early 2000's.
Building Population:	The school houses approximately 585 students in grades K through 4 and approximately 130 staff.
Windows:	Openable

Methods

Please refer to the IAQ Manual for methods, sampling procedures, and interpretation of results (MDPH, 2015).

IAQ Testing Results

The following is a summary of indoor air testing results (Table 1).

- ***Carbon dioxide levels*** were below 800 parts per million (ppm) in three out of four areas assessed, indicating adequate fresh air in the space.
- ***Temperature*** was within the recommended range of 70°F to 78°F in all areas assessed.

- ***Relative humidity*** was below the recommended range of 40% to 60% in all areas assessed.
- ***Carbon monoxide*** levels were non-detectable in all indoor areas assessed.
- ***Fine particulate matter (PM2.5)*** concentrations measured were below the National Ambient Air Quality Standard (NAAQS) level of 35 micrograms per cubic meter ($\mu g/m^3$) in all areas assessed.

Ventilation

Fresh air in original building classrooms is supplied by unit ventilators (univents). A univent is designed to draw air from outdoors through a fresh air intake located on the exterior wall of the building. Return air is drawn through an air intake located at the base of each unit where fresh and return air are mixed, filtered, heated or cooled and provided to classrooms through an air diffuser located in the top of the unit (Figure 1).

Rooms 113A, 113B, 115B and the adjoining restroom appear to have been one open room when originally built. Subsequently, the room was subdivided by the addition of an interior wall to separate Room 113A from Room 113B. Room 113B is part of a suite with Room 115B and a restroom. The univent that originally provided fresh air for the open room is now divided by the wall. This configuration directs heat and airflow into the dividing wall, which may aerosolize dust and debris inside the wall. Room 115B has a wall-mounted radiator and an exhaust vent. Exhaust ventilation in classrooms in the original building is provided by vents located in the ceilings of coat closets. Room 113A was separated from its exhaust vent by the previously-mentioned dividing wall. Rooms 113B, 115B and the restroom all have exhaust vents. Room 115A has neither fresh air supply or exhaust ventilation.

It is important to note that the univents in this school are original equipment, approximately 45-50 years old. Function of equipment of this age is difficult to maintain, since compatible replacement parts are often unavailable. According to the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE), the service life for a unit heater, hot water or steam, is 20 years, assuming routine maintenance of the equipment (ASHRAE, 1991). Despite attempts to maintain the univents, the operational lifespan of the equipment has been exceeded. Maintaining the balance of fresh air to exhaust air will become

more difficult as the equipment ages and as replacement parts become increasingly difficult to obtain.

The relative humidity readings ranged from 9 to 14 percent, which were below the MDPH recommended comfort range the day of the assessment. The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. "Extremely low (below 20%) relative humidity may be associated with eye irritation [and]…may affect the mucous membranes of individuals with bronchial constriction, rhinitis, or cold and influenza related symptoms" (Arundel et al., 1986). Low relative humidity is a common problem during the heating season in the northeast part of the United States. Exacerbating this problem is the operation of dehumidifiers in this area during the assessment. Dehumidifiers should be operated when the outdoor relative humidity exceeds the upper comfort range, >60 percent. The relative humidity measured outdoors was 21 percent, which would make dehumidification in the RES unnecessary.

Microbial/Moisture Concerns

Water damage to wood adjacent to the window sills was noted. Window frame temperatures were measured in a range from 37°F to 43°F, while the outdoor temperature was 32°F (Table 1). The windows are on the north-facing exterior walls and receive minimal sun exposure. These low temperatures, in comparison with room temperatures, indicate that the windows and frames are not energy efficient and can serve as thermal bridges. Where a thermal bridge exists, condensation is likely to form on the warm side of the cold object which can moisten materials, such as wooden window sills. Repeated exposure to moisture/condensation can lead to mold. Attached to this wall are large cork bulletin boards which may also have water damage on the surface where it attaches to the exterior wall.

The United States Environmental Protection Agency (US EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommend that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2008; ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Once

mold has colonized porous materials, they are difficult to clean and should be removed and discarded.

Other IAQ Evaluations

Room 115B has a number of gym mats on the walls and floors. The radiator that provides heat to this room is behind gym mats on the wall. Heating from the radiator may increase the release of plastic odors from the gym mats. Phthalates are frequently used as a plasticizer in synthetic materials and are considered semi-volatile organic compounds (SVOCs). SVOCs are materials that do not readily aerosolize at room temperature (78°F), but can evaporate when heated. SVOCs can cause eye, nose and respiratory irritation when aerosolized.

Conclusions/Recommendations

Based on observations at the time of assessment, the following is recommended:

1. Remove water-damaged wood from adjacent to windows.
2. Remove cork bulletin boards from beneath windows and check for water damage to the boards and underlying wall. If boards are water-damaged/mold-colonized, discard them, otherwise, they may be relocated to an interior wall.
3. Examine the feasibility of installing the gym mats in Room 115B in such a manner as to allow for air to be drawn by the radiators to increase airflow and reduce heating of the mats.
4. Discontinue the use of dehumidifiers in low relative conditions. Use dehumidifiers only during times of hot, humid weather when relative humidity is greater than 60 percent outdoors.
5. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

6. Operate supply and exhaust ventilation continuously in all areas during occupied periods. Ensure all HVAC equipment is maintained and supply and return vents are cleaned periodically to prevent dust re-aerosolization.
7. Refer to resource manual and other related IAQ documents located on the MDPH's website for further building-wide evaluations and advice on maintaining public buildings. These documents are available at: http://mass.gov/dph/iaq.

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

Arundel et al. 1986. Indirect Health Effects of Relative Humidity on Indoor Environments. Env. Health Perspectives 65:351-361.

ASHRAE. 1991. ASHRAE Applications Handbook, Chapter 33 “Owning and Operating Costs”. American Society of Heating, Refrigeration and Air Conditioning Engineers, Atlanta, GA.

MDPH. 2015. Massachusetts Department of Public Health. Indoor Air Quality Manual: Chapters I-III. Available at: http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/iaq/iaq-manual/.

US EPA. 2008. “Mold Remediation in Schools and Commercial Buildings”. Office of Air and Radiation, Indoor Environments Division, Washington, DC. EPA 402-K-01-001. March 2001. Available at: https://www.epa.gov/mold/mold-remediation-schools-and-commercial-buildings-guide.

Location: Richer Elementary School **Indoor Air Results**

Address: 80 Foley Road, Marlborough, MA

Table 1

Date: 2/10/2017

	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m^3)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Intake	Exhaust	
Background	343	ND	32	21	30					
113A	610	ND	72	11	2	0	Y	Y	Y	Water-damaged sill wood
113B	324	ND	74	9	4	2	Y	Y	Rest room vent	Water-damaged sill wood
115A	1107	ND	76	14	5	7	N	N	Y	Dehumidifier in use
115B	700	ND	76	11	5	0	N	N	Y	Gym mats on wall and floor

ppm = parts per million µg/m^3 = micrograms per cubic meter ND = non-detect

Comfort Guidelines

Carbon Dioxide:	< 800 ppm = preferred	Temperature:	70 - 78 °F
	> 800 ppm = indicative of ventilation problems	Relative Humidity:	40 - 60%